COMPUTER SYSTEMS INC.

"QUICK & TIMELY"

SILENCE+ 6, 8, 12, & 18 SLOT MOTHER BOARD MANUAL

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MOTHERBOARD MANUAL

CONTENTS

WARRANTY

The merchandise sold hereunder is of the best quality obtainable by QT Computer Systems, Inc., within the performance and price considerations of the competitive market. QT Computer Systems, Inc., will for a period of one (1) year following delivery to customer, repair or replace any unit that is found to contain defects in materials or workmanship, provided:-

1. Such defect in material or workmanship existed at the time of delivery.
2. The unit is promptly returned to QT Computer Systems, Inc., at customers' expense for examination to confirm the alleged defect, and for subsequent repair or replacement.
3. Proof of purchase and time of sale must accompany claim.
4. This warranty is void for bare boards or kits except for parts, quality, completeness of, for unaltered or assembled parts.

QT SILENCE PLUS MOTHER BOARD FEATURES

* S-100 BUS Compatable to IEEE Standard

* Six, Eight, Twelve or Eighteen Slots

* 0.125" x 0.25" 100 Pin Edge Connectors

* 5½" x 8½" – 6 Slot; $6^{13}/_{16}$" x 9" – 8 Slot; 9¾" x 8½" – 12 Slot; 15" x 8½" – 18 Slot.

* Aerospace Quality Epoxy Board

* Double Shielded Mesh Ground Planes

* No Passive or Active Termination Required

* No Power Consumption or Signal Distortion from Termination Requirements

* Very High Signal Crosstalk Rejection

* No Perceptible Noise to 14 MHz

* LED Power Indicator

* Bare Boards, Kits or Completed Boards Available

NOTE: 8" Slot Mother Board has provision for Power Connector.

DESCRIPTION

The QT Motherboard is one of the latest and finest quality motherboards currently being manufactured and sold to the general public. It has been tested to 14 MHz with no perceptible noise, by oen of the largest mainframe manufacturers, and is currently being purchased by them. Quiet performance is built into the board design and construction, by using double laminated mesh construction.

There are many motherboards on the market using different methods to combat or get around noise problems. The following dissertation will hopefully explain some of the differences and give you an understanding of the quiet qualities of the QT SILENCE + Motherboard.

Currently, digital computers are running at clock speeds between 500 KHZ and 15 MHZ. As a result, RF radiation causes interference and cross talk, commonly referred to as "noise". Interference to radios, TV sets, and other nearby computers subsequently becomes a problem, together with the distortion and mixing of internal timing signals within the computer.

Since putting a conventional grounded shield cable around each pin connector wire would be obviously very expensive and difficult to achieve for 100 pin connectors, the first attempts to reduce noise were by using a ground plane on one side of the board. Unfortunately, the capacitive effects then had deleterious effects on what were, until then, square wave timing signals.

The next approach was to use what are referred to as terminators. There are two general types of terminators; 1) active, 2) passive. A passive terminator consists of two resistors, one going to the power source and the other to ground with the signal line connected between, and sometimes, a bypass capacitor to short the high frequencies to ground. Active terminators are about the same, except they connect to the power source through an active component, such as an amplifier.

Passive terminators consume signal power causing the use of heavier current capacity components, or more of them, to provide adequate signal strength. Active terminators pull more current from the power source necessitating larger power supplies, and more heat dissapation. Neither of those approaches solve the basic problem caused by 94 cross linking wires from each of the 100 pin connectors, which act as 94 RF antennas. At these frequencies, the wires radiate RF, result in cross talk and signal radiation.

The approach taken on the QT SILENCE+ Motherboard is to surround each signal wire with a ground line. These ground lines are interwoven top and botton into a mesh. The signals respond as though they are running between two infinite ground planes. Since the ground wires are actually a mesh, they have minimal capacitive effect. A secondary benefit is the inductive reflectance. As a signal reverses in a line, it generates a magnetic field such as in a transformer. Since each line is surrounded by a ground plane, it cannot couple magnetic current flow in the next signal line and because of the mirror-like reflection from the ground lines, the magnetic fields are suppressed or effectively eliminated.

Because of the design and construction of the mesh ground planes, the QT SILENCE+ Motherboard never needs termination, runs quiet, consumes less current, allows use of smaller power sources and generates less heat. The distributed capacitive inductance of the mesh network was designed precisely with enough capacitance to prevent ringing.

BARE BOARDS AND KITS

All QT SILENCE+ Motherboards are checked for continuity and inter-line shorts before they leave the factory. We have also selected the best connectors that are the least susceptible to wicking and other problems.

CAUTION! If you are building on a bare board or a kit, check your kit before assembly. Damage to the boards or components are not warrantable once they have been soldered.

Unless you are expert with a soldering iron and have the proper temperature controlled equipment, we recommend you buy the completed and tested motherboard. Soldering the board under less than excellent conditions will normally result in wicking or peeled connecting wires. Too much heat or the application of too much solder will inevitably result in "wicking" which is when solder runs down the pins of the connectors and puddles on the component side of the board, thus shorting out signal lines.

IEEE S100 BUS SPECIFICATIONS

The QT SILENCE+ Motherboard is manufactured to IEEE S100 Bus Specifications. This specification provides for ground lines on pins 53, 20 and 70 in addition to the old ground lines at pins 50 and 100. There are a few boards which use these pins for signals.

Under the old definitions, pin 53 was Sense Switch Disable. Many CPU boards including the JADE IA/Z80, BIG Z and Z+80 Rev. 1, use this line. Under the IEEE definitions it is a ground line. This effectively halts the CPU, therefore the pine on the CPU card must be cut. If the signal is required for a front panel, it may be routed over the jumper cable connecting the CPU with the front panel board.

Pins 20 and 70 were formerly defined as Memory Protect/Unprotect respectively. Under the IEEE definitions, these are both grounds. This may create some problems with older-style memory boards which use this feature. You should update your boards to conform to the IEEE S100 Bus Standard Pinout, enclosed in this manual. For most boards, this is a relatively simple fix. Many boards will not even have to be modified, since the S-100 standard was designed to conform to the configuration of as many S-100 style cards as possible.

PARTS LIST

	You should have received	Check off here
QT SILENCE+ Motherboard	1	
R1, 220 ohm, ½watt resistor (red, red, brown)	1	
D1, LED	1	
S-100 Card Connectors	6, 8, 12 or 18	

CONSTRUCTION AND SOLDERING TIPS

Choose a well-lighted work space with enough room to place your tools, parts and instructions. If you have two light sources that can be adjusted, this will help eliminate shadows which interfere with seeing your work.

Familiarize yourself with all of the general operations to be performed. It might even help to do a dry run.

The tools you will need for each individual kit will be listed in the assembly instructions. A basic set would include: a low wattage soldering iron (20 watts or less), and with a 650 tip if you can get one, a holder which will keep you from accidentally touching the top tip, a pair of wire cutters (also called dykes or side cutters, preferably beveled so that you can cut close to the board), a pair of needle-nose pliers, a damp sponge or a moistened cloth to use to wipe the soldering iron's tip, a magnifying glass to examine details, and a lead former to bend leads. The latter is available at most electronics parts houses in an inexpensive plastic version, or you can make your own out of wood. If you're into building lots of electronic kits, they're worth their weight in gold.

Arrange your tools in order of their frequency, and use them so they are easy to reach. Make sure they are clean and in good working order.

Keep your work eara clean and uncluttered.

Make sure that your chair is set at a proper height and is comfortable for your work station.

Try to keep food and drink away from your area. Always strive for neatness and uniformity. This means removing bits and pieces of scrap wire and solder blobs, as you work so they don't become buried in your board and short something out. Inevitably, according to Murphy's Law, they will sneak underneath IC sockets, and if there is a place that's hardest to get to and fix, that's exactly where they"ll lodge.

Soldering can cause several different kinds of problems in kit building. Heat can damage the PC board and the components, especially diodes and transistors, or create unwanted electrical connections. Most problems can be eliminated by using the right soldering iron (and the right solder-resin core, NOT acid core), and by developing an efficient technique.

Parts are inserted on the component (front) side of the board. Soldering is done on the back side. This is always a rule, unless you are specifically directed otherwise in the assembly instructions.

If you plan on building many kits (and one memory board can be many kits), spend a few extra dollars to buy yourself a quality temperature-controlled soldering station. Spending the $30 can save you from ruining a $200 kit.

Use only ROSIN CORE SOLDER when constructing electronic kits. Never, never, not ever, use acid core — — that's only for pipes and sheet metal. A solder with a high ratio of tin to lead is important. 60/40 is good, but 63/37 is excellent, and the difference will amaze you. Get 63/37 at QT Computer Systems, or at your local electronics parts house.

Make sure you have a well-tinned tip. A tip is well-tinned when it has a thin film of solder coating on the surface of the iron. Oxide and resin will build up as you work with it and the bright shiny look will disappear. That's what the wet sponge or moistened cloth is for. The iron should be wiped clean about every ten connections or so to get rid of that oxide and resin. Copper-tipped irons are fairly good, but gold-coated ones are much better.

Some DON'Ts: DON'T have an unnecessary items at your work station. DON'T use worn or damaged tools. NEVER solder equipment that is plugged in. DON'T use unknown cleaning solutions. DON'T pull on a solder joint to see it it's good. NEVER flip excess solder from the tip of your iron — — use the sponge or cloth. NEVER put solder on your iron and then transfer it to a cold joint.

Heat both the component wire and the solder pad with the tip of the iron until it looks wet or liquid. Then touch the solder to the junction between the iron, the pad and the wire. When the solder melts and flows onto the connection, quickly remove the iron's tip. Allow the joint to cool without moving any of the components. A good joint will be smooth and bright. A bad one will be a dull, lead-looking, glob of solder.

AVOID USING TOO MUCH SOLDER. From our experience at repairing customer's boards, this is the sin most often committed. If little drops of solder appear on the opposite side of the board, you're either using too much solder or too much heat. Be extremely careful when you solder adjacent pads because the heat may cause the solder to flow between them, making a solder 'bridge'. Bridges are only good for crossing rivers — — they don't belong on electronic boards. They make an unwanted electrical connection.

If you do find a bridge, the best way to remove it is to clean your iron on the dampened sponge and then touch the bridge with the clean hot tip until it wets and sticks to the tip. Then get rid of it.

Excess wire can be removed with diagonal cutters. WAIT till the joint has cooled. Beware of flying pieces of wire. ALWAYS USE EYE PROTECTION WHEN SOLDERING OR CUTTING WIRE.

After you're all done, use Freon solvent to remove the flux. Flux is that brown stuff that gets on the boards near your soldering joints, and it is formed of burned rosin. Not only does it look bad (preventing your wonderful soldering job from looking all bright and shiny), it can cause electrical headaches as well, especially in higher frequency circuits. Not only this, but it makes it much more difficult to find bridges and shorting flakes, since the resin hides the solder under an effective cover-up. Leave cover-ups to politicians — — clean your board.

QT technical support people have found out that a board works about like it looks. If it's been put together with care and good workmanship, it will work just fine. In life, you only get out of it what you put into it, and it works the same with electronic kits.

ASSEMBLY INSTRUCTIONS

We suggest you start at a time when you will be able to complete it without interruption. Mark the check ( ) as you do each step. This kit could be assembled several ways, but if you follow these step-by-step directions your assembly problems should be fewer.

1. Make sure you've the tools needed. For this kit you need the following:— a soldering iron (20 watts maximum), ROSIN CORE solder (preferably 63/37), cutters a small magnifying glass, a screwdriver and a lead form.

2. Check PARTS RECEIVED against the PARTS LIST. Take special care to correctly identify look-alike parts; i.e., resistors, capacitors and diodes. If anything is missing, please call QT Customer Service Department.

3. Read the section called: Construction and Soldering Tips.

CAUTION: USE EYE PROTECTION WHILE SOLDERING OR CUTTING WIRE!

4. Begin the assembly by inserting the 100-pin edge connectors into the Motherboard. You will notice that there are rows of plated-through holes between the holes for the connectors. These have been arranged so that is is impossible to insert a connector into them. It is not necessary to inspect the board for plating errors, since this has already been done during manufacturing. Every board is thoroughly checked for continuity and shorts between leads.

5. The S-100 connectors should all face the same way. Place the side with the writing toward the front of the board. The front of the board is the edge that has the LED Connections on it, and the top of the board is the side that is marked "connector side".

6. When all the connectors have been inserted, place the foam lid of the shipping container firmly against the top of the connectors and carefully turn the board over, pressing it firmly down onto the table top.

7. Inspect the connector pins to make sure that all of them came through in their proper holes, and none of them have gotten bent under.

8. Solder pins 1 and 100 of each connector, on a diagonal line across the connector.

9. Now turn the board over and carefully inspect the placement of this connector. They should be flush with the top of the board. This is IMPORTANT, since the proper placement of the connectors will help prevent wicking. If any of them are floating off the top of the board, carefully heat the corner pins while pushing down on the top of the connector.

10. Turn the board back over and solder all the connector pins. It is helpful to do one entire row of pins at a time. Don't leave the job with a partially-soldered row, since it is easy to overlook unsoldered pins. If you have to leave the job, wait until you've finished a whole row.

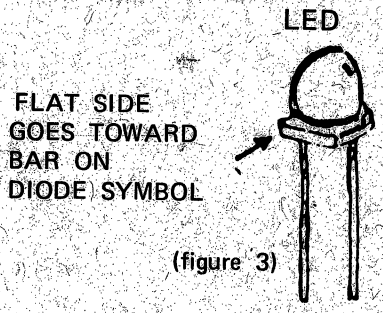
11. When you're ready to solder a joint, apply heat to the joint first, then apply the soldering to the opposite side of the joint from the iron (see figure). Then remove the solder, and finally remove the soldering iron. We have reflow-soldered these boards, which means that they already have some solder on them, so don't use too much solder. As soon as the joint looks wet and begins to liquify, apply the solder. This should take about two seconds with a decent iron. The iron should not be left on the joint longer than two or three seconds after the solder has been first applied. A good solder joint has an even flow of solder over the entire joint. A bad solder joint, commonly called a "cold" solder joint, will have a dull lead-like appearance. Do not move the part or the board while the solder is cooling, or a cold or fractured solder joint will result (see figure 2).

12. Patience is a virtue, especially when assembling Motherboards. On a six-slot bus there are over 600 connections to make, 1200 on the twelve slot, and 1800 on an eighteen slot. Every one of these must be perfect. The board was designed to be wave-flow soldered. If you do not have the patience to correctly assemble it, return the bare board or the kit NOW, and buy an assembled unit, QT Computer Systems will NOT guarantee, repair or replace any Motherboard assembled from a bare board or kit.

13. When the connectors have been soldered in place, take an ohm meter and place the common lead on the ground. Test each and every signal joint on every connector for a short to ground. Then test adjacent signal traces. (Pin 1 against 5) and pin 2; pin 2 against pin 1, 51, 52, 53, and 3, etc.). If wicking has occurred and a glob of solder is shorting out the traces, the short is most likely to occur between a signal line and ground, and is also most likely to be located underneath the connectors on the top of the board.

14. Form the resistor as per Figure 3, and insert it at the rear right of the board (see Component Placement Diagram). Solder it and cut off the excess leads.

15. Form the LED diode leads as per figure 4, and insert it. Solder it and cut off the excess leads. Do NOT insert it backwards. Make certain that the cathode side goes toward the bar on the diagram on the board. (see Component Placement Diagram.).



(figure 3)

DIODE SYMBOL

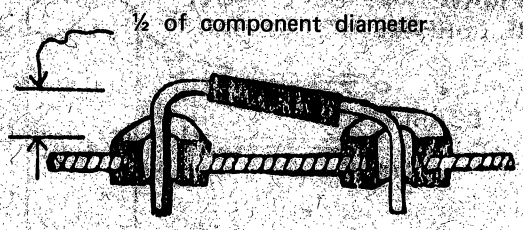
(figure 4)

COMPONENT INSTALLATION AND SOLDERING TECHNIQUES

Install all components in their proper location, and if polarity is important, observe the proper markings. The component should be installed flush with the circuit board, unless a clearance is specifically called out. This clearance is usually required for hot components that might burn or discolor the printed circuit board.

The lead should have a discernable length extending straight from the body of the component before beginning the bend. The component body shall not be damaged, nor the body-to-lead seal damaged, by the forming operation. The component should be centered between the bends, although this is not a requirement. Where feasible, all forming should be done so that the part number is visible when installed in the circuit board.

GOOD (before soldering)



ACCEPTABLE

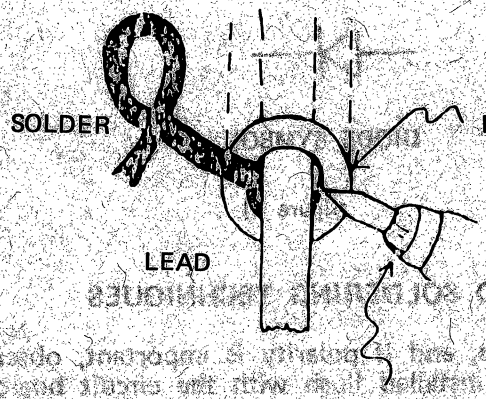
SOLDERING

Soldering techniques probably are the hardest to master of any electronic assembly technique. If you have never soldered at all, it is probably best that you practice on some old scrap printed circuit board available at most electronic parts store and surplus shops.

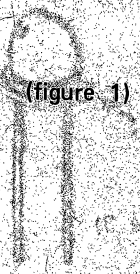
For electronic assembly, always use resin core solder, not acid core solder. Acid core solder will corrode, and it's impossible to stop the corrosion. It will eventually ruin the printed circuit board.

A soldering iron of small wattage, preferably 27 watts maximum, should be used. Always keep the tip clean and free from dross (oxidized solder) by wiping on a moistened sponge or folded-up Kleenex (moistened). Use small solder with a 60-40 ration (60% tin and 40% lead).

When ready to solder a joint, apply heat to the joint first, then apply the solder to the opposite side of the joint from the iron (see Figure 1). Then remove the solder and finally the soldering iron. A good solder joint has an even flow of solder over the entire joint. A good joint will have a bright, glistening look. A bad solder joint, commonly called a cold solder joint, will have a dull appearance. Also, do not move the part or lead while the solder is cooling or a cold or fractured solder joint will result (see Figure 2).



(figure 1)

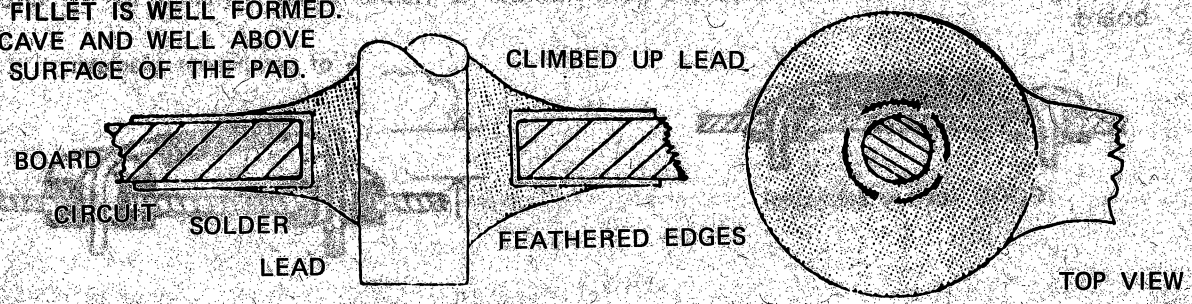


APPLY SOLDER TO OPPOSITE SIDE OF LEAD FROM THE SOLDERING IRON.

(figure 2a)

OPTIMUM JOINT

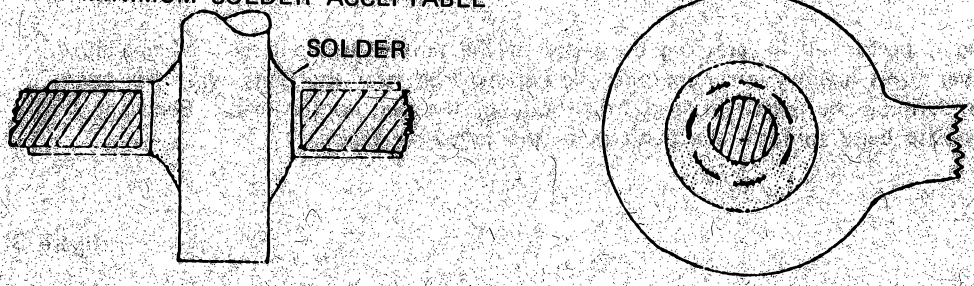
THE FILLET IS WELL FORMED. CONCAVE AND WELL ABOVE THE SURFACE OF THE PAD.



THE SOLDER MUST BE CLEAN, SMOOTH & BRIGHT.

(figure 2b)

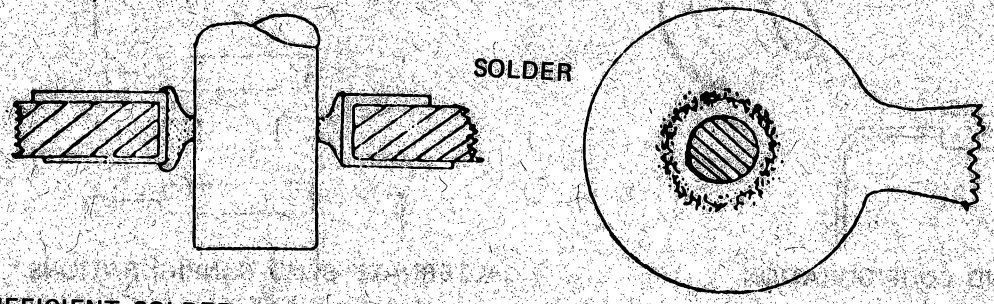
MINIMUM SOLDER ACCEPTABLE



SOLDER FLOW RESULTING IN A MINUTE FILLET RADIUS ON EITHER OR BOTH SIDES OF THE BOARD IS ACCAPTABLE.

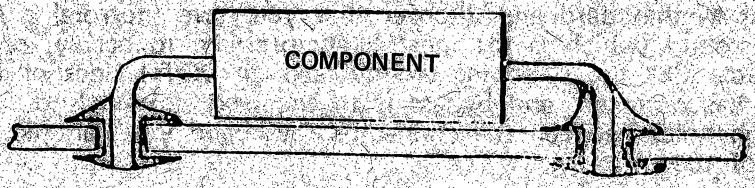
(figure 2c)

INSUFFICIENT SOLDER



INSUFFICIENT SOLDER, INDICATED BY LACK OF FILLET ON ONE OR BOTH SIDES OF THE BOARD.

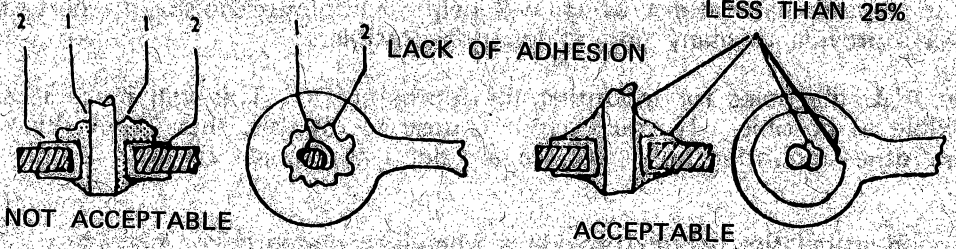
(figure 2d)



ACCEPTABLE

STRESS RELIEF AND SOLDER BUILD-UP ON AXIAL LEAD COMPONENTS AT LEAST ONE END OF AXIAL LEAD COMPONENTS SHALL HAVE ADEQUATE STRESS RELIEF AND ABSENCE OF SOLDER BUILD UP.

(figure 2e)



NOT ACCEPTABLE

ACCEPTABLE

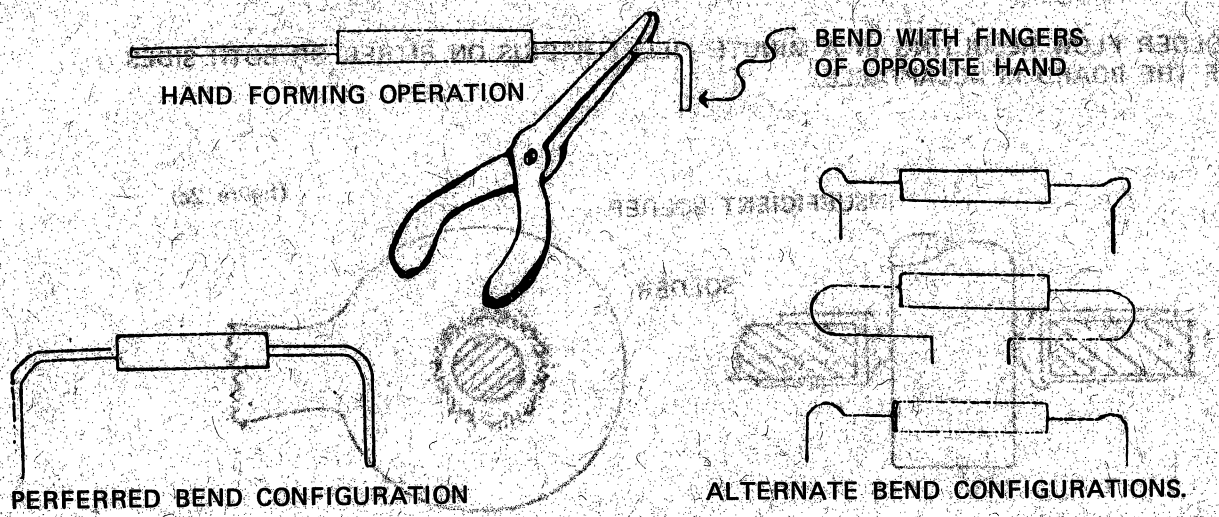
LACK OF ADHESION INDICATED BY EVIDENCE (1) THE LEAD IS NOT WET ON COMPONENT SIDE, OR (2) THE PAD IS NOT WET AT THE SOLDER PAD INTERFACE.

LACK OF ADHESION CONFINED TO LESS THAN 25% OF THE LEAD PERIMETER SHALL BE ACCEPTABLE PROVIDED THE LACK DOES NOT EXTEND BENEATH BOARD SURFACE. IF DEFECT EXTENDS BELOW, THE LIMIT IS 10% OF LEAD PERIMETER.

LEAD FORMING

Lead forming is performed by grasping the body of the part with the fingers of one hand. With the other hand holding long-nose pliers, grasp the lead near the body with the taper of the pliers defining the length of lead from body of the part to the lead. Bend the lead with the opposite hand to form the bend as in the following figure.

(figure 3)



REPAIRS

If you have assembled your Motherboard and discover that you have (horrors) a short between a signal line and ground (which is the most likely problem to occur), don't despair — — it can be fixed. Cut the offending ground lead on BOTH sides of the connector where the short has occurred, and bypass it to the next ground lead. There are a row of plated through-holes between the connector rows, and you can pick up your ground lead on one of these.

INSTALLATION

When you have completed your assembly, and you're ready to install it in your main-frame, here are a few tips and hints that will help you with a trouble-free installation.

1. Connect ALL power leads, using #14 gauge wire minimum. There is a reason for this. On the 6, 12 and 18 slot Motherboards, there is one lead for each voltage supply and one lead for ground for each 6 slots. These are distributed, from the lead pads, in a particular pattern which will help to minimize noise. In particular you should always provide as many ground leads as possible.

2. Use ALL the holes for mounting the Motherboard. This will make it as stiff and unflexible as possible. If you do not choose to do this, then don't skip more than every other mounting hole. Above all, don't try to get by with a bolt at each corner.

3. A good installation would provide a fiberglass, masonite, or plexiglass sheet underneath the Motherboard. This both insulates the Motherboard from chassis ground and makes it extremely stiff and unflexing. Plexiglass can be obtained at most local hardware stores or building supply companies.

IEEE S-100 PIN CONNECTIONS

PIN 1	+ 8 volts DC Supply, no amperage specified	
PIN 2	+ 16 volts DC Supply, no amperage specified	
PIN 3	XRDY	
PIN 4	VIO*	(Vectored Interrupt Lines)
PIN 5	V11*	
PIN 6	V12*	
PIN 7	V13*	
PIN 8	V14*	
PIN 9	V15*	
PIN 10	V16*	
PIN 11	V17*	
PIN 12	NIM*	(non-maskable interrupt line) OPEN COLLECTOR
PIN 13	PWR FAIL*	(DC Power Failure, Non-maskable interrupt)
PIN 14	DMA3*	(DMA request line) OPEN COLLECTOR
PIN 15	A18	
PIN 16	A16	
PIN 17	A17	
PIN 18	STAT DSB*	(Status disable) OPEN COLLECTOR
PIN 19	C/C DSB*	(Command disable/Control disable) OPEN COLLECTOR
PIN 20	GND	(Ground)
PIN 21	NDEF	(Not to be defined)
PIN 22	ADD DSB*	(Address disable) OPEN COLLECTOR
PIN 23	DO DSB*	(Data output disable) OPEN COLLECTOR
PIN 24	O(B)	(System master timing clock signal)
PIN 25	pSTVAL*	(Status valid strobe)
PIN 26	pHLDA	(Hold acknowledge to coordinate DMA Xfer)
PIN 27	RFU	(Reserved for future use)
PIN 28	RFU	(Reserved for future use)

PIN 29	A5	PIN 30	A4	PIN 31	A3
PIN 32	A15	PIN 33	A12	PIN 34	A9
PIN 35	D01	PIN 36	D00	PIN 37	A10
PIN 38	D04	PIN 39	D05	PIN 40	D06
PIN 41	D12	PIN 42	D13	PIN 43	D17

PIN 44	sMI	(Instruction Op code fetch cycle signal)
PIN 45	sOUT	(Data transfer to an output device)
PIN 46	sINP	(Data transfer from an input device)
PIN 47	sMEMR	(Memory Read)
PIN 48	sHLTA	(Halt acknowledge)
PIN 49	Clock*	(2MHz (2%) 40/60 duty cycle clock. No reference to any other bus signals).
PIN 50	GND	
PIN 51	+8 volts DC Supply, no amperage specified	
PIN 52	-16 volts DC Supply, no amperage specified	
PIN 53	Ground	
PIN 54	SLAVE CLR*	(Signal from Bus Master to clear Bus Slave Device) OPEN COLLECTOR
PIN 55	DMAO*	(DMA Request line) OPEN COLLECTOR
PIN 56	DMAI*	OPEN COLLECTOR
PIN 57	DMA2*	OPEN COLLECTOR
PIN 58	SXTRQ*	(Signal requesting a 16-bit data transfer)
PIN 59	A19*	
PIN 60	SIXTN*	(Signal granting a 16-bit data transfer from a Bus device) OPEN COLLECTOR
PIN 61	A20*	
PIN 62	A21*	
PIN 63	A22*	
PIN 64	A23	
PIN 65	NTD	(Not to be defined)
PIN 66	NTD	(Not to be defined)
PIN 67	PHANTOM*	OPEN COLLECTOR
PIN 68	MWRITE*	
PIN 69	RFU	(Reserved for future use)
PIN 70	Ground	
PIN 71	NTD	
PIN 72	RDY	OPEN COLLECTOR
PIN 73	INT*	OPEN COLLECTOR
PIN 74	pHOLD	OPEN COLLECTOR
PIN 75	pRESET*	OPEN COLLECTOR

PIN 76	pSYNC	PIN 77	pWR*	PIN 78	pDBIN
PIN 79	A0	PIN 80	A1	PIN 81	A2
PIN 82	A6	PIN 83	A7	PIN 84	A8
PIN 85	A13	PIN 86	A14	PIN 87	A11
PIN 88	D02	PIN 89	D03	PIN 90	D07
PIN 91	D14	PIN 92	D15	PIN 93	D16
PIN 94	D11	PIN 95	D10	PIN 96	sINTA
PIN 97	sWO*	PIN 98	ERROR*	PIN 99	POC*
PIN 100	Ground				